

Computer Science Program in Moroccan Secondary Schools: Curricula Analysis

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Abstract—The methodology of teaching informatics is a reflection subject that arouses increasing interest both locally and internationally. Debates on the curricula of the discipline are always at the center of many discussions amongst computer scientists and other concerned educators. Teaching Computer science in secondary schools is increasingly perceived as having similar status like teaching mathematics, life and earth sciences, chemistry, and physics. In this paper we report and analyze the current status of computer science education in Moroccan secondary schools in light of the governing official instructions by the ministry of education. We also discuss the generalization of computer education in Moroccan secondary schools probing the emergence of teaching it as a disciplinary subject rather than a tool in other fields. Our analysis shows that teaching informatics in Morocco is not conform to the set ministerial objectives and it necessitate a reform in both its teaching methodology and content.

Index Terms—Computer science in Morocco, Computer science discipline, Computer science curricula.

I. INTRODUCTION

Computer science is currently considered as a fundamental component in educational curricula [1-5] and discussions about its content is still at the center of many debates [6-8]. Indeed, information technology (IT) is a field of knowledge in perpetual evolution, and as a result, computer-based education, presumably more than any other scientific discipline, requires a continuous

renewal of its programs and the innovation in its teaching strategies and approaches.

Our basic motivation in this article is to shed light on the current status of computer science education in Moroccan secondary schools. After a brief historical overview of the different actions that led to the generalization of secondary computer science education, we present an analysis of these programs in contrast with the main official instructions of the discipline both in middle school and high schools. It appears from our analysis that despite the current efforts made by the National Ministry of Education, teaching informatics in Morocco is not up to the set objectives and its teaching methodology and content needs an urgent reform.

II. EMERGENCE OF COMPUTER SCIENCE DISCIPLINE

Computer science as a school subject is relatively a new topic. Computer science has evolved over the last century and has benefited from the development of mathematics, the emergence of electronics and automatism. Its status as an independent school subject began to take shape in the sixties of last century.

Currently, this status of computer science as a "school subject" is widely accepted by almost all educational systems around the globe. However, even if the need to introduce computer science discipline into the school curricula is unanimous, the approaches adopted and the experiments carried out, differ from one country to another, they depend on the social and / or cultural context in each country [9,10,11]. Such differences result in a multiplicity of conceptions in computing fields, that

school must then provide a wide variety of content implementation approaches.

Indeed, the divergence already appears at the nomenclature level and more precisely at the vocabulary

level that designate computer science subject. We note several labels of this discipline as summarized in (Table1).

Table 1. Different labels for computer science subject

| Label | Definition |
|---|---|
| Information and Communication Technologies (ICT). | A global term that embraces a full range of electronic tools that enable us to transmit, process, store, create, display, share, and exchange information with others [12] |
| Informatics, Computer Science | Encompasses the study of computers and algorithmic processes, including their principles, their hardware and software designs, their applications, and their impact on society [13, 14] |
| Educational Technology | The use of computer tools (hardware and software) to advance student learning in other disciplines [13, 15]. |
| Digital literacy and fluency | Represent a set of curricula from literacy and the simple use of technological tools to mastery and the ability to express ideas creatively via these tools [13, 16] |

Reading the attributes relating to these labels reflects the fact that the discipline oscillates between technical and theoretical aspect.

Besides computer science subject title, contents and approaches used to their integration into the educational curriculum still arouse debate and although they are common, they show some differences.

III. RELATED WORK

In the past few years, several countries have proceeded a full revision of their curricula promoting "computer science" as a school discipline having similar status as mathematics, physical sciences and chemistry [7,13].

- In England, the new curricula, introduced in 2014 [4], present the current trend for teaching informatics in primary and secondary schools namely. It emphasizes teaching computer thinking, video-based instruction and the introduction of visual environments such as Scratch [17] and Kodu [18], environments that make programming fun and accessible for young children [19].
- Computer science "informatyka" and ICT existed since 1985 as a school subject in Poland [20, 21]. The new ICT curriculum launched in 2015, is addressed at all students in K-12. Its main purpose is to motivate students to develop computational thinking competency and to use problem solving in various subjects [22].
- The French Academy of Sciences¹ reported in their annual report of 2013 that "the general education of informatics will first have to empower all citizens with keys to the future world, which will be much more digital and thus computerized than the world today, so that they understand it and can participate consciously in its choices and its evolution rather than just being exposed to it as consumers while things are decided elsewhere". In this context the current trend by the government aims to make compulsory

the teaching of computer coding starting in primary schools².

- In Japan, the new curricula, which will be implemented starting 2020, states that all primary students will be introduced to programming and all high school students will have to learn computer science [23].

In addition, and in order to encourage students to learn computer science, several initiatives have been conducted lately: Code.org, Hour Code, Europe Code Week, and Africa Code Week [14], which invite millions of students all around the world to the field of programming in an entertaining and enjoyable way.

IV. BRIEF HISTORY ON TEACHING COMPUTER SCIENCE IN MOROCCO

Like many educational systems, Morocco undertook informatics integration tests in the 1980s. In high schools, this teaching was left to the initiative of the computer science teachers who were called "Computer animators". Thus, where it existed, the computer science discipline was based on learning algorithms and programming in Basic or Pascal and on the use of tutorials and programs for learning other school subjects such as mathematics and languages. In middle school, basic programming courses and activities on the use of office automation software were integrated into the subject of technology [25]. In fact, it can be said that there was no clear vision or strategy separating informatics as subject matter (full-fledged school discipline) and IT as a tool for learning other disciplines. This situation lasted throughout the 90s, despite the fact that a project to introduce computer science in the last two years of qualifying secondary education, especially for the scientific disciplines, was introduced during the 1998-1999 academic year [26].

It was not until the advent of the National Charter for Education and Training, which was the framework document for orientations and educational philosophy in 1999, that the integration of informatics as a separate subject in the field of education in the Moroccan

¹www.academie-sciences.fr/activite/rapport/rads_0513.pdf

²www.assemblee-nationale.fr/14/propositions/pion2022.asp

education system was considered [27]. Thus, in the 2001-2002 academic years, three decisions in favor of the implementation of IT integration project were made:

- The creation of a new professionals executives:
 - Computer science inspectors: after a two-year training at the Training Center of Inspectors of Education (CFIE)
 - Secondary school teachers: after a one-year training course in the Regional Centers for Education and Training (CRMEF). These new teachers were designated to teach computer science mainly at the middle school level.
- The increase in the number of computer science teachers, both for middle and high schools.

The designation of computer science as a school discipline with well-defined objectives began to be established after the graduation of the first cohort of inspectors in 2003. In fact, each inspector was in charge of the elaboration of a program specific to its regional academy assignment. They have therefore tried to generalize computer science education in middle schools and high schools which have computer science teachers [26]. These efforts culminated in 2005 with the release of official instructions related to teaching computer science. It should be noted, however, that CS teaching was limited to the core curriculum (1st year of high school, all sectors combined) because of shortage in the number of CS teachers. It's only in 2007 that computer science was generalized to all 3 levels in middle schools. However, informatics teaching official instructions in middle schools were only issued in 2009. Figure 1, shows the timeline of computer science education in Morocco.

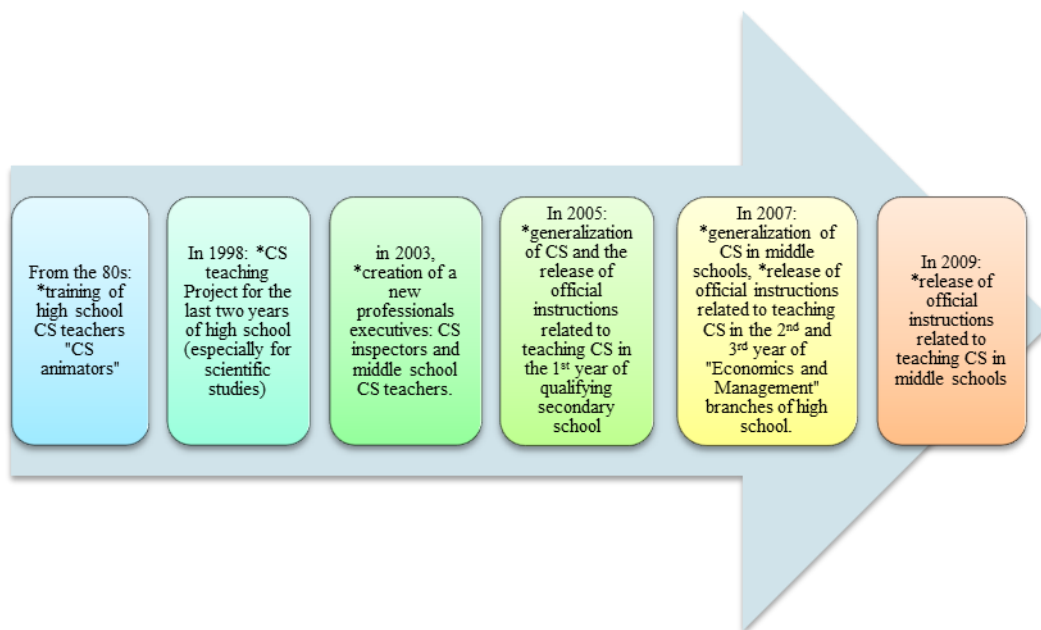


Fig.1. Timeline of computer science education in Morocco

V. TEACHING COMPUTER SCIENCE AS A DISCIPLINE IN MOROCCO

A. Computer Science in primary school

Enabling pupils to use ICT is one of the aims in primary education [28]. However, when analyzing the official instructions of primary education in Morocco, it is found that the term informatics is mentioned only once. These instructions, however ambiguous, present indications on the use of digital resources in teaching.

In practice, ICT exploitation remains very restricted and limited to initiatives by a minority of teachers mainly involved in digital content production projects and/or innovative educational projects like CITI, COLLAB,

etc.[29]. However, we could highlight few experiences of computer education in the private sector, where computer science is integrated in the curriculum, a way to attract more students to these institutions. Manuals have been produced containing fun activities helping to develop algorithmic thinking of the learner [30].

B. Computer Science in middle school

In middle school, the computer science discipline, on one hand, aims at having students use ICTs to search, process and communicate information and on the other hand initiate them since the 2nd year to the programming concept and problem solving (Table 2).

Table 2. Content of the computer science curriculum in middle schools [31]

| Content Item | 1 st year | 2 nd year | 3 rd year |
|-------------------------------------|---|---|--|
| Computer and Operating Systems (OS) | -IT system (4h) -OS (4h) -Documentary research (6h) | - Hardware environment of a computer system (4h) - Operating system and local network (2h) - Information exchange in a local network (2h) | -Network Typology (2h) |
| Use of Software | - Creating a drawing file, and an audio file (2h) -Text analysis (14h) | - Spreadsheets (12h) | -Computer-assisted presentations (10h) |
| Programming | | - Logo Programming (10h) | - Logo Programming (8h) |
| Internet | | | -Web documentary researches (6h) -E-Mail (4h) |

C. Computer Science in high school

In the first year of high school, the program focuses on the use of ICT and the introduction of algorithmics and programming [27]. It is organized in four modules, the content of each comprises a set of coherent units. The level of deepening the notions varies according to each field of study.

Computer science at the 2nd and 3rd year of high school is taught at the level of the economic science and management branch: "IT management". The program is mainly focused on IT tools like word processing software, spreadsheets, internet services, management and accounting [32, 33].

Table 3 presents the content of the computer science discipline at high school level.

Table 3. Content of the IT Program in High School [27, 32, 33]

| Item \ Content | 1 st year (Common Core) | 2 nd year (1 st year BAC) | 3 rd year (2 nd year BAC) |
|-----------------------------|---|--|---|
| IT System basics | -Definitions and basic vocabulary (2h) -Basic computer structures (4h) -Types of software (1h) -Application domains (1h) | | |
| Software | -OS (6h) -Text processing (10h) -Spreadsheets (6) | -Word processing on Windows (22h) | - Spreadsheets (36h) -Software SAARI (32h) |
| Algorithmic and programming | -Basic algorithm concepts (4h) -Basic control structures (6h) -Programming languages (6h) | | |
| Networks & Internet | -Basic IT network concepts (4h) -Internet network (10h) | -Internet : Research, downloading, E-Mail....(12h) | |

The computer science program in high schools seems varied and reflects the dual aspect of the discipline varying from theoretical to technical learning components. Nevertheless, it can be highlighted that:

- There is a lack of continuity and complementarity between the computer program at the middle school level and the 1st year in high school (core curriculum). Knowledge and know-how do not follow a precise order both in terms of difficulties and the level of concepts and themes. For example: concepts such as loops and procedures in the middle school program are absent in the 1st year of high school curriculum, as well as notions of array and other data structures. Moreover, the same notions taught in middle school are taken up in the first year of high school without any deepening study: computer networks and Internet, word processing software, spreadsheet ...
- In the 2nd and 3rd year of high school, computer science is only taught in the "Economics and Management" branches. The program is mainly focusing on informatics as tool.

VI. CONCLUSION

Computer science is currently omnipresent in all school subjects, it provides tools to master various technologies in perpetual development. The analysis of the content of this discipline and how it is currently taught in Morocco shows the following:

- there is a lack of a computer discipline at the primary level;
- there is a lack of continuity and complementarity between the computer program in middle school and the first year of high school. Knowledge and know-how do not follow a precise order both in terms of difficulties and the level of concepts and themes ;
- the teaching of IT in general education remains limited to the level of the 1st year of high school ;
- practically speaking, computer science education in middle schools is limited to the second year only;

- computer and internet courses are often flown over due to the lack of network equipment and/or the fact that it appears at the end of the program;
- the textbook, programs and official instructions for computer science education have never been reviewed or reformed since they were developed in 2005 for high school (Common Core) and in 2007 in the case of middle school. Thus, for a field that is experiencing rapid and continuous developments, computer skills currently taught are not -necessarily-adapted to the needs of today's learners ;
- only one cohort of twenty educational inspectors of the computer discipline was trained in 2003. At the present time, the number of these inspectors does not exceed ten, which limits the pedagogical accompaniment and the in-service training of teachers.

It therefore seems that despite the efforts made by the Ministry, the teaching of computer science is not up to the objectives set and that its teaching and content in force are to be reformed.

It should be noted that if we want to establish a computer science discipline with the academic standards, informatics as "tool" shouldn't take the upper hand and therefore, we must go beyond literacy, office automation. As a result, informatics subject needs to be addressed at a higher level, as a science of modeling, reasoning, analysis, problem-solving and creativity. Thus, the balance between the two aspects "Informatics as tool" and "Informatics as science" must be maintained and reviewed according to the school level and age of the learners (table 4).

Table 4. Teaching informatics as a tool and science (***) very important, (**) moderately important, (*) slightly important

| | Primary school | Middle school | High school |
|-----------------------------|----------------|---------------|-------------|
| Informatics as a tool / ICT | *** | ** | * |
| Informatics as a science | * | ** | *** |

In fact, as students advance in their education program; computer science education, and especially algorithmic thinking and programming, must evolve accordingly.

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